

SESSION II

DETECTION AND GENERAL DETERRENCE

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Upon successfully completing this session, the participant will be able to:

- o Describe the frequency of DWI violations and crashes.
- o Define General Deterrence.
- o Describe the Relationship between Detection and General Deterrence.
- o Describe a brief history of alcohol;
- o Identify common types of alcohols;
- o Describe the physiologic processes of absorption, distribution and elimination of alcohol in the human body;

CONTENT SEGMENTS

- A. The DWI Problem
- B. The Concept of General Deterrence
- C. Relating Detection to Deterrence Potential
- D. Evidence of Effective Detection and Effective Deterrence
- E. Physiology of Alcohol

LEARNING ACTIVITIES

- o Instructor-Led Presentations
- o Reading Assignments

DWI DETERRENCE: AN OVERVIEW

Each year, tens of thousands of people die in traffic crashes. Throughout the nation, alcohol is the major contributor to traffic fatalities. In 2002, alcohol-related fatalities rose to 17,419, representing 41 percent of all traffic fatalities. (NHTSA 2002 FARS data)

Impaired drivers are more likely than other drivers to take excessive risks such as speeding or turning abruptly. Impaired drivers also are more likely than other drivers to have slowed reaction times. They may not be able to react quickly enough to slow down before crashing and are less likely to wear seatbelts. On the average, two percent of drivers on the road at any given time are DWI. DWI violations and crashes are not simply the work of a relatively few "problem drinkers" or "problem drug users." Many people commit DWI, at least occasionally.

- o In a 1991 Gallup Survey of 9,028 drivers nationwide, 14% of the respondents reported they drove while close to or under the influence of alcohol within the last three months.

It is conservatively estimated that the typical DWI violator commits that offense about 80 times per year. In other words, the average DWI violator drives while under the influence once every four or five nights.

THE PROBLEM OF DWI

HOW WIDESPREAD IS DWI?

While not all of those who drive after drinking have a BAC of 0.08/0.10 or more, the presumptive or illegal per se limit for DWI in many states, some drivers do have BACs in excess of these limits.

A frequently quoted, and often misinterpreted, statistic places the average incidence of DWI at one driver in fifty. Averaged across all hours of the day and all days of the week, two percent of the drivers on the road are DWI.¹ That 1 in 50 figure is offered as evidence that a relatively small segment of America's drivers the so called "problem" group account for the majority of traffic deaths. There's nothing wrong with that figure as a statistical average, but police officers know that at certain times and places many more than two percent of drivers are impaired. National Highway Traffic Safety Administration research suggests that during the late night, weekend hours, as many as ten percent of drivers on the roads may be DWI.² On certain holiday weekends, and other critical times, the figure may go even higher.

HOW MANY? HOW OFTEN?

The issue of how many DWIs are on the road at any given time is an important

factor in measuring the magnitude of the problem. However, from an overall traffic safety perspective, the more important issue may be the number of drivers who ever commit DWI. Just how widespread is this violation? In enforcement terms, how many people do we need to deter?

Clearly, it is more than one in fifty. Although it may be true that, on the average, two percent of drivers are DWI at any given time, it certainly is not the same two percent every time. It is even more than one in ten. Not everyone who commits DWI is out on the road impaired every Friday and Saturday night. Some of them, at least, must skip an occasional weekend. Thus, the ten percent who show up, weekend after weekend, in the Friday and Saturday statistics must come from a larger pool of violators, each of whom "contributes" to the statistics on some nights, but not necessarily on all nights.

An analysis of BAC roadside survey data suggests that the average DWI violator commits the violation approximately 80 times each year.³ Undoubtedly, there are some who drive impaired virtually everyday; others commit the violation less often. It is likely that at least one quarter of all American motorists drive while impaired at least once in their lives. That figure falls approximately midway between the 55 percent of drivers who at least occasionally drive after drinking and the ten percent of weekend, nighttime drivers who have BACs above the so called legal limit.

- 1 Borkenstein, R.F., et al, Role of Drinking Driver in Traffic Accidents. Bloomington IN: Department of Police Administration, Indiana University, March 1964.
- 2 Alcohol Highway Safety Workshop, Participant's Workbook Problem Status. NHTSA, 1980.
- 3 DWI Law Enforcement Training: Instructor's Manual. NHTSA. August 1974. P.139.

Our estimated one in four drivers includes everyone who drives impaired everyday, as well as everyone who commits the violation just once and never offends again; and it includes everyone in between. In short, it includes everyone who ever runs the risk of being involved in a crash while impaired.

SOCIETY'S PROBLEM AND THE SOLUTION

It really doesn't matter whether this one in four estimate is reasonably accurate (in fact, it is probably low). The fact is that far more than two percent of American drivers actively contribute to the DWI problem. DWI is a crime committed by a substantial segment of Americans. It has been and remains a popular crime; one that many people from all walks and stations of life commit. DWI is a crime that

can be fought successfully only through a societal approach of comprehensive community-based programs.

GENERAL DETERRENCE

One approach to reducing the number of drinking drivers is general deterrence of DWI. General deterrence of DWI is based in the driving public's fear of being arrested. If enough violators come to believe that there is a good chance that they will get caught, at least some of them will stop committing DWI at least some of the time. However, unless there is a real risk of arrest, there will not be much fear of arrest.

Law enforcement officers must arrest enough violators enough of the time to convince the general public that they will get caught, sooner or later, if they continue to drive while impaired.

How many DWI violators must be arrested in order to convince the public that there is a real risk of arrest for DWI? Several programs have demonstrated that significant deterrence can be achieved by arresting one DWI violator for every 400 DWI violations committed. Currently, however, for every DWI violator arrested, there are between 500 and 2,000 DWI violations committed. (See Exhibit 2-1) When the chances of being arrested are one in two thousand, the average DWI violator really has little to fear.

EXHIBIT 2-1



Chances of a DWI violator being arrested are as low as 1 in 2000.

Why is the DWI arrest to violations ratio (1:2000) so low? There are three noteworthy reasons.

- o DWI violators vastly outnumber police officers. It is not possible to arrest every drinking driver each time they commit DWI.
- o Some officers are not highly skilled at DWI detection. They fail to recognize and arrest many DWI violators.
- o Some officers are not motivated to detect and arrest DWI violators.

SIGNIFICANT FINDINGS

In a 1975 study conducted in Fort Lauderdale, Florida, only 22 percent of traffic violators who were stopped with BACs between 0.10 and 0.20 were arrested for DWI. The remainder were cited for other violations, even though they were legally impaired. In this study breath tests were administered to the violators by researchers after the police officers had completed their investigations. The officers failed to detect 78 percent of the DWI violators they investigated.

The implication of this study, and of other similar studies, is that for every DWI violator actually arrested for DWI, three others are contacted by police officers, but are not arrested for DWI. (See Exhibit 2-2.) It is clear that significant improvement in the arrest rate could be achieved if officers were more skilled at DWI detection.

EXHIBIT 2-2



For every DWI violator arrested, 3 others are contacted face to face by police, but are not arrested.

Several enforcement programs have succeeded in achieving significant DWI deterrence. Consider, for example, the three year intensive weekend DWI enforcement program in Stockton, California. Under that program:

- o arrests increased 500 percent;
- o weekend nighttime crashes decreased 34 percent;
- o the proportion of nighttime weekend drivers legally under the influence dropped from nine percent to six percent.

Improved DWI detection can be achieved in virtually every jurisdiction in the country. The keys to success are police officers who are:

- o skilled at DWI detection;
- o willing to arrest every DWI violator who is detected;
- o supported by their agencies in all aspects of this program, from policy through practical application.

THE SOLUTIONS

THE ULTIMATE GOAL: CHANGING BEHAVIOR

What must comprehensive community based DWI programs seek to accomplish? Ultimately, nothing less than fundamental behavioral change, on a widespread basis. The goal is to encourage more Americans to:

- o avoid committing DWI, either by avoiding or controlling drinking prior to driving or by selecting alternative transportation.

- o intervene actively to prevent others from committing DWI (for example, putting into practice the theme "friends don't let friends drive drunk");
- o avoid riding with drivers who are impaired.

The final test of the value of DWI countermeasures on the national, state and local levels is whether they succeed in getting significantly more people to modify their behavior. The programs also pursue other more immediate objectives that support or reinforce the ultimate goal. However, the ultimate goal is to change driving while impaired to an unacceptable form of behavior at all levels.

PURSUING THE GOAL: TWO APPROACHES

How can we bring about these changes in behavior? How can we induce more people to avoid DWI violations, prevent others from drinking and driving, and avoid becoming passive "statistics" by refusing to ride with drinking drivers? Basically, there are two general approaches that must be taken to achieve this goal. One: prevention -- gives promise of the ultimate, lasting solution to the DWI problem; but it will require a substantial amount of time to mature fully. The other -- deterrence -- only offers a partial or limited solution, but it is available right now.

PREVENTION: THE ULTIMATE SOLUTION

DWI countermeasures that strive for the ultimate achievement of drinking and driving behavioral changes have been grouped under the label "Prevention." There are many kinds of DWI preventive activities. Some are carried out by and in our schools, some through the mass media, some through concerned civic groups, and so forth. The various preventive efforts focus on different specific behaviors and address different target groups. However, they seek to change drinking and driving behavior by promoting more positive attitudes and by fostering a set of values that reflects individual responsibilities toward drinking and driving.

Preventive countermeasures seek society's acceptance of the fact that DWI is wrong. Some people believe that drinking and driving is strictly an individual's personal business; that it is up to each person to decide whether or not to accept the risk of driving after drinking. Preventive activities try to dispel that outmoded and irresponsible belief. Instead, they promote the idea that no one has the right to endanger others by drinking and driving, or to risk becoming a burden (economically and otherwise) to others as a result of injuries suffered while drinking and driving. Realistically, everyone has an obligation not only to control their own drinking and driving, but also to speak up when others are about to commit the violation. Only when all of society views DWI as a negative behavior that cannot be tolerated or condoned, will the public's behavior begin to change. That is the long-term solution.

DWI prevention will never be 100 percent successful. In reality, there will always be people who drink and drive. However, with new sets of values come new behaviors. For example, one need only look at the proliferation of "Thank You for Not Smoking" signs. Displaying such a sign a generation ago would have been viewed as impolite, if not anti-social. Today, "No Smoking" policies are strictly enforced in many work areas.

DWI prevention through basic shifts in attitudes and values can work. Given enough time, it will work. The key word is time. A full generation or more must grow to maturity before new attitudes take hold and start to change behavior. We can look at today's children and expect that their attitude toward drinking and driving will be different from their parents; however, we need an interim solution, and we need it NOW.

DWI DETERRENCE

DETERRENCE: THE INTERIM SOLUTION

DWI countermeasures that seek a short-cut to the ultimate goal of behavioral change generally are labeled "Deterrence." Deterrence can be described as negative reinforcement. Some deterrence countermeasures focus primarily on changing individual drinking and driving behavior while others seek to influence people to intervene into others' drinking and driving decisions.

The key feature of deterrence is that it strives to change DWI behavior without dealing directly with the prevailing attitudes about the rightness or wrongness of DWI. Deterrence uses a mechanism quite distinct from attitudinal change: fear of apprehension and application of sanctions.

THE FEAR OF BEING CAUGHT AND PUNISHED

Large scale DWI deterrence programs try to control the DWI behavior of the driving public by appealing to the public's presumed fear of being caught. Most actual or potential DWI violators view the prospect of being arrested with extreme distaste. For some, the arrest, with its attendant handcuffing, booking, publicity and other stigmatizing and traumatizing features, is the thing most to be feared. For others, it is the prospective punishment (jail, stiff fine, etc.) that causes most of the concern. Still others fear most the long-term costs and inconvenience of a DWI arrest: the license suspension and increased premiums for automobile insurance. For many violators the fear probably is a combination of all of these. Regardless, if enough violators are sufficiently fearful of DWI arrest, some of them will avoid committing the violation at least some of the time. Fear by itself will not change their attitudes; if they do not see anything inherently wrong with drinking and driving in the first place, the prospect of arrest and punishment will not help them see the light. However, fear sometimes can be enough to keep them from putting their anti-social attitudes into practice.

This type of DWI deterrence, based on the fear of being caught, is commonly called general deterrence. It applies to the driving public generally and presumably affects the behavior of those who have never been caught. There is an element of fear of the unknown at work here.

Another type of DWI deterrence, called specific deterrence, applies to those who have been caught and arrested. The typical specific deterrent involves some type of punishment, perhaps a fine, involuntary community service, a jail term or action against the driver's license. The punishment is imposed in the hope that it will convince the specific violator that there is indeed something to fear as a result of being caught, and to emphasize that if there is a next time, the punishment will be even more severe. It is the fear of the known that comes into play in this case.

The concept of DWI deterrence through fear of apprehension or punishment seems sound. But will it work in actual practice? The crux of the problem is this: If the motoring public is to fear arrest and punishment for DWI, they must perceive that there is an appreciable risk of being caught and convicted if they commit the crime. If actual and potential DWI violators come to believe that the chance of being arrested is minimal, they will quickly lose whatever fear of arrest they may have felt.

Enforcement is the mechanism for creating and sustaining a fear of being caught for DWI. No specific deterrence program can amount to much, unless police officers arrest large numbers of violators; no punishment or rehabilitation program can affect behavior on a large scale unless it is applied to many people. General deterrence depends on enforcement -- the fear of being caught is a direct function of the number of people who are caught.

Obviously, the police alone cannot do the job. Legislators must supply laws that the police can enforce. Prosecutors must vigorously prosecute DWI violators, and the judiciary must adjudicate fairly and deliver the punishments prescribed by law. The media must publicize the enforcement effort and communicate the fact that the risk is not worth the probable outcome. Each of these elements plays a supportive role in DWI deterrence.

HOW GREAT A RISK IS THERE?

The question now is, are violators afraid of being caught? More importantly, should they be afraid? Is there really an appreciable risk of being arrested if one commits DWI?

The answer to all of these questions unfortunately is: probably not. In most jurisdictions, the number of DWI arrests appears to fall short of what would be required to sustain a public perception that there is a significant risk of being caught.

Sometimes, it is possible to enhance the perceived risk, at least for a while, through intensive publicity. However, media "hype" without intensified enforcement has never been enough to maintain the fear of arrest for very long.

HOW MUCH SHOULD THE PUBLIC FEAR?

We can draw some reasonable estimates of DWI enforcement intensity, based on what we know and on certain assumptions we have already made. Suppose we deal with a random sample of 100 Americans of driving age. If they come from typical enforcement jurisdictions, chances are that exactly one of them will be arrested for DWI in any given year: our annual DWI arrests, in most places, equal about one percent of the number of drivers in the population. That is one arrest out of 100 drivers during one year; however, how many DWI violations do those drivers commit? Recall our previous estimates that some 25 percent of America's drivers at least occasionally drive while under the influence, and that the average violator commits DWI 80 times each year. Then, our sample of 100 drivers includes 25 DWI violators who collectively are responsible for 2,000 DWI violations yearly.

CHANGING THE ODDS

If an arrest/violation ratio of 1 in 2,000 is not enough to make deterrence work, is it then reasonable to think that we can ever make deterrence work? After all, if we doubled DWI arrests to 1 in 1,000, we would still be missing 999 violators for every one we managed to catch. If we increased arrests ten-fold, to 1 in 200, 199 would escape for every one arrested. How much deterrence would that produce?

Surprisingly, it would probably produce quite a bit. We don't have to arrest every DWI offender every time in order to convince them that they have something to fear. We only have to arrest enough of them enough of the time to convince many of them that it can happen to them. As the arrest rate increases, the odds are that it will happen to them eventually. The law of averages (or cumulative probability) will catch up with them, and sooner than we might at first expect.

The statistics below display the cumulative probability (as a percentage) of being arrested at least once during the course of one, two or three years as a function of the arrest rate on any given night. These statistics are based on the assumption that the average violator commits DWI 80 times each year.

Percent of violators arrested after...

Nightly Arrest Rate	One Year	Two Years	Three Years
1 in 2000	3.9%	7.7%	11.3%
1 in 1000	7.7%	14.8%	21.3%
1 in 500	14.8%	27.4%	38.2%
1 in 200	33.0%	55.2%	70.0%

Clearly, the chances of being caught accumulate very quickly as the arrest/violation ratio increases. If we could maintain a ratio of one arrest in every 500 violations (a level of enforcement currently maintained in some jurisdictions), then by the time one year has passed, slightly more than one of every seven people (14.8%) who have committed DWI during that year will have been arrested at least once. It probably is a high enough chance to get the attention -- and fear -- of many violators. If we could achieve an arrest ratio of 1 in 200 (a level attainable by officers skilled in DWI detection) we will arrest fully one-third of all DWI violators at least once every year, and we will arrest more than half of them by the time two years have gone by.

DWI DETECTION: THE KEY TO DETERRENCE

CAN IT BE DONE, AND WILL IT WORK?

Is there any evidence that a practical and realistic increase in DWI enforcement activity will induce a significant degree of general deterrence and a corresponding change in DWI behavior? Yes there is.

As early as 1975, in the city of Stockton, California, a study showed that the city's total number of DWI arrests (700) were considerably less than one percent of the areas licensed number of drivers (130,000). The implication here was that Stockton police were only maintaining the arrest/violation ration of 1-2,000, or less. In addition, roadside surveys on Friday and Saturday nights disclosed that nine percent of the drivers were operating with BAC's of 0.10 or higher.

Then things changed. Beginning in 1976 and continuing at planned intervals through the first half of 1979, Stockton police conducted intensive DWI enforcement on weekend nights. The officers involved were extensively trained. The enforcement effort was heavily publicized and additional equipment (PBTs and cassette recorders) was made available. The police effort was closely coordinated with the District Attorney's office, the County Probation office, and other allied criminal justice and safety organizations. All this paid off. By the time the project came to a close (in 1979) DWI arrests had increased by over 500 percent, and weekend nighttime collisions had decreased by 34 percent, and the number of operators committing DWI dropped one-third.

Since the historical Stockton study numerous states have conducted similar studies to determine the degree of effect that DWI arrests would have on alcohol related fatalities in general, and total fatalities in particular. Most of these studies were conducted between 1978 and 1986.

The results of these studies graphically illustrated in each state that when the number of arrests for DWI increased, the percent of alcohol related fatalities decreased. Further, the results of a study conducted in Florida from 1981 - 1983, showed that when DWI arrests per licensed driver increased, total fatalities decreased (12-month moving average).

DETECTION: THE KEY TO DETERRENCE

It is important to understand how increased DWI enforcement can affect deterrence. Deterrence can vastly exceed the level of enforcement officers achieve on any given night. True, weekend DWI arrests can increase by as much as 500 percent, as in the Stockton study. However, even though the study showed they started with an enforcement ratio no better than 1-in-2000, the tremendous increase in DWI arrests probably only brought the arrest ratio to about 1-in-400. Regardless of the fact that 399 DWI drivers avoided arrest, the increased enforcement effort convinced at least one-third of the violators to change their behavior substantially.

The law of averages quickly starts to catch up with DWI drivers when the enforcement ratio improves to the 1-in-400 ratio. At that level, unless violators change their behavior, many of them will be caught, or at least will have known someone who has been arrested. Coupled with the heavy publicity given to the enforcement effort, those experiences were enough to raise the perception level of apprehension among DWI operators that sooner or later they would be caught. As a result, many of them changed their behavior. This is the best example of general deterrence.

In addition, during the same time that DWI arrests went up over 500 percent in Stockton, citations for other traffic violations increased by a comparatively modest 99 percent. The implication is that Stockton's officers were stopping and contacting only twice as many possible violators as they had before, but they were coming up with more than five times as many arrests.

What have the results of these studies shown? Basically, they have shown that a community will benefit from their officers' increased skills at DWI detection. Principally because of their special training, the officers were better able to recognize "cues" of impairment when they observed vehicles in motion, and they were more familiar with the "clues" or human indicators of impairment exhibited by violators during personal contact. The officers also had more confidence in the field sobriety tests they used to investigate their suspects. The most important factor was that far fewer of the violators being stopped now avoided detection and arrest.

The difficulty in detecting DWI among operators personally contacted by officers has been well documented. Analysis of roadside survey and arrest data suggest that for every DWI violator arrested, three others actually have face-to-face contact with police officers but are allowed to go without arrest.⁴ Direct support of that inference was found in the Fort Lauderdale BAC study, where researchers demonstrated that police officers arrested only 22 percent of the DWI operators they contacted, whose BAC levels were subsequently shown to be between 0.10 and 0.20.⁵

⁴ DWI Law Enforcement Training, op. cit.

⁵ Fort Lauderdale BAC Study.

The ability to detect DWI violators is the key to general deterrence and possibly, the greatest impediment to it. If we accept the three-to-one ratio of failed detections as being reasonably accurate, the implications are rather alarming. Consider the impact on a DWI violator's subsequent behavior when, after being stopped by the police, is allowed to continue driving. Very likely, these DWI violators and their friends will become even more convinced of their ability to handle drinking and driving. Further, they will come to believe that they will never be arrested because police officers can't determine when they are "over the limit." Instead of creating general DWI deterrence, this attitude breeds specific reinforcement. This helps to develop a feeling among DWI violators that they have nothing more to fear from police than an occasional ticket for a minor traffic offense.

On the positive side, the ratio of undetected to detected violations suggests that much can be accomplished with existing resources, if we use those resources as efficiently as possible. By just being able to improve detection skills of law enforcement officers we could experience an increase in the arrest/violation ratio of 4-in-2000 without any increase in contacts.

PHYSIOLOGY OF ALCOHOL

A BRIEF OVERVIEW OF ALCOHOL

Alcohol is the most abused drug in the United States.



"Alcohol" is the name given to a family of closely related and naturally-occurring chemicals. Each of the chemicals that is called an "alcohol" contains a molecule chemists refer to as a "hydroxy radical." This radical contains one oxygen atom and one hydrogen atom bonded together. The simplest alcohol has only one carbon atom, three hydrogen atoms, and one hydroxy radical. The next alcohol has two carbon atoms, five hydrogen atoms and one hydroxy radical. The third alcohol has three carbon atoms, seven hydrogen atoms and one hydroxy radical. That is how the alcohols differ from one another.

Alcohols are molecularly very similar and produce similar effects. They produce intoxicating effects when ingested into the human body. Only one of them is meant for human consumption. However, when ingested in substantial quantities it can cause death.

The ingestible alcohol is known as ethyl alcohol, or ethanol. Its chemical abbreviation is ETOH. The "ET" stands for "ethyl" and the "OH" represents the single oxygen atom bonded to one of the hydrogen atoms, ("hydroxy radical"). Ethanol is the variety of alcohol that has two carbon atoms. Two of ethanol's best known analogs are methyl alcohol (or methanol), commonly called "wood alcohol", and isopropyl alcohol (or isopropanol), also known as "rubbing alcohol".

Ethanol is what interests us, because it is the kind of alcohol that features prominently in impaired driving. Ethanol is beverage alcohol, the active ingredient in beer, wine, whiskey, liquors, etc. Ethanol production starts with **fermentation**. That is a kind of decomposition in which the sugars in fruit, grains and other organic materials combine with yeast to produce the chemical we call ethanol. This can occur naturally, as yeast spores in the air come into contact with decomposing fruit and grains. However, most of the ethanol in the world didn't ferment naturally, but was produced under human supervision.

When an alcoholic beverage is produced by fermentation, the maximum ethanol content that can be reached is about 14%. At that concentration, the yeast dies, so the fermentation stops. Obtaining a higher ethanol content requires a process called **distillation**. This involves heating the beverage until the ethanol "boils off", then collecting the ethanol vapor. It is possible to do this because ethanol boils at a lower temperature than does water.

Distilled spirits is the name we give to high-ethanol-concentration beverages produced by distillation. These include rum, whiskey, gin, vodka, etc. The ethanol concentration of distilled spirits usually is expressed in terms of **proof**, which is a number corresponding to twice the ethanol percentage. For example, an 80-proof beverage has an ethanol concentration of 40 percent.

Over the millennia during which people have used and abused ethanol, some standard-size servings of the different beverages have evolved. Beer, for example, is normally dispensed in 12-ounce servings. Since beer has an ethanol concentration of about four percent, the typical bottle or can of beer contains a little less than one-half ounce of pure ethanol. A standard glass of wine has about four ounces of liquid. Wine is about 12 percent alcohol, so the glass of wine also has a bit less than one-half ounce of ethanol in it. Whiskey and other distilled spirits are dispensed by the "shot glass", usually containing about one and one-quarter ounce of fluid. At a typical concentration of forty percent ethanol (80-proof), the standard shot of whiskey has approximately one-half ounce of ethanol. Therefore, as far as their alcoholic contents are concerned, **a can of beer, a glass of wine and a shot of whiskey are all the same.**

PHYSIOLOGIC PROCESSES

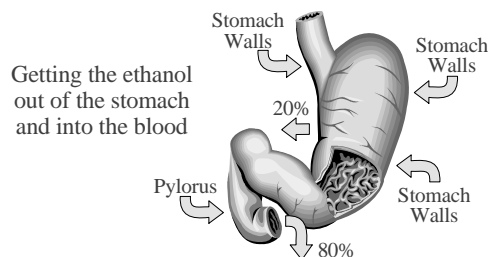
Ethanol is a Central Nervous System Depressant. It doesn't affect a person until it gets into their central nervous system, i.e., the brain, brain stem and spinal cord. Ethanol gets to the brain by getting into the blood. In order to get into the blood, it has to get into the body.

There are actually a number of different ways in which ethanol can get into the body. It can be **inhaled**. Ethanol fumes, when taken into the lungs, will pass into the bloodstream and a positive blood alcohol concentration (BAC) will develop.

However, prolonged breathing of fairly concentrated fumes would be required to produce a significantly high BAC. Ethanol could also be **injected**, directly into a vein; it would then flow with the blood back to the heart, where it would be pumped first to the lungs and then to the brain. And, it could be **inserted**, as an enema, and pass quickly from the large intestine into the blood. But none of these methods are of any practical significance, because alcohol is almost always introduced into the body orally, i.e., by drinking.

Absorption

Once the ethanol gets into the stomach, it has to move into the blood. The process by which this happens is known as **absorption**. One very important fact that pertains to alcohol absorption is that it doesn't have to be digested in order to move from the stomach to the blood. Another very important fact is that alcohol can pass directly through the walls of the stomach. These two facts, taken together, mean that -- under the right circumstances -- absorption of alcohol can be accomplished fairly quickly. The ideal circumstance for rapid absorption is to drink on an empty stomach.



When the alcohol enters the empty stomach, about 20 percent of it will make its way directly through the stomach walls. The remaining 80 percent will pass through the base of the stomach and enter the small intestine, from which it is readily absorbed into the blood. Because the body doesn't need to digest the alcohol before admitting it into the bloodstream, the small intestine will be open to the alcohol as soon as it hits the stomach.

But what if there is food in the stomach? Suppose the person has had something to eat shortly before drinking, or eats food while drinking; will that affect the absorption of alcohol?

Yes it will. Food has to be at least partially digested in the stomach before it can pass to the small intestine. When the brain senses that food is in the stomach, it commands a muscle at the base of the stomach to constrict, and cut off the passage to the small intestine. The muscle is called the **pylorus**, or pyloric valve. As long as it remains constricted, little or nothing will move out of the stomach and into the small intestine. If alcohol is in the stomach along with the food, the alcohol will also remain trapped behind the pylorus. Some of the alcohol trapped in the stomach will begin to break down chemically before it ever gets into the blood. In time, as the digestive process continues, the pylorus will begin to relax, and some of the alcohol and food will pass through. But the overall effect will be to slow the absorption significantly. Because the alcohol only slowly gets into the blood, and because the body will continue to process and eliminate the alcohol that does manage to get in there, the drinker's BAC will not climb as high as it would have if he or she had drunk on an empty stomach.

Distribution

Once the alcohol moves from the stomach into the blood, it will be distributed throughout the body by the blood. Alcohol has an affinity for **water**. The blood will carry the alcohol to the various tissues and organs of the body, and will deposit the alcohol in them in proportion to their water contents. Brain tissue has a fairly high water content, so the brain receives a substantial share of the distributed alcohol. Muscle tissue also has a reasonably high water content, but fat tissue contains very little water. Thus, very little alcohol will be deposited in the drinker's body fat. This is one factor that differentiates alcohol from certain other drugs, notably PCP and THC, which are very soluble in fat.

The affinity of alcohol for water, and its lack of affinity for fat, helps explain an important difference in the way alcohol affects women and men. Pound for pound, the typical female's body contains a good deal less water than does the typical man's. This is because women have additional adipose (fatty) tissue, designed in part to protect a child in the womb. A Swedish pioneer in alcohol research, E.M.P. Widmark, determined that the typical male body is about 68% water, the typical female only about 55%. Thus, when a woman drinks, she has less fluid -- pound for pound -- in which to distribute the alcohol.

If a woman and a man who weighed exactly the same drank exactly the same amount of alcohol under the same circumstances, her BAC would climb higher than his. When we couple this to the fact that the average woman is smaller than the average man, it becomes apparent that a given amount of alcohol will cause a higher BAC in a woman than it usually will in a man.

Elimination

As soon as the alcohol enters the blood stream, the body starts trying to get rid of it. Some of the alcohol will be directly expelled from the body chemically unchanged. For example, some alcohol will leave the body in the breath, in the urine, in sweat, in tears, etc. However, only a small portion (about 2-10%) of the ingested alcohol will be directly eliminated.

Most of the alcohol a person drinks is eliminated by **metabolism**. Metabolism is a process of chemical change. In this case, alcohol reacts with oxygen in the body and changes, through a series of intermediate steps, into carbon dioxide and water, both of which are directly expelled from the body.

Most of the metabolism of alcohol in the body takes place in the liver. An enzyme known as **alcohol dehydrogenase** acts to speed up the reaction of alcohol with oxygen. The speed of the reaction varies somewhat from person to person, and even from time to time for any given person. On the average, however, a person's blood alcohol concentration -- after reaching peak value -- will drop by about 0.015 per hour. For example, if the person reaches a maximum BAC of 0.15, it will take about ten hours for the person to eliminate all of the alcohol.

For the average-sized male, a BAC of 0.015 is equivalent to about two-thirds of the alcohol content of a standard drink (i.e., about two-thirds of a can of beer, or glass of wine or shot of whiskey). For the average-sized female, that same BAC would be reached on just one-half of a standard drink. So the typical male will eliminate about two-thirds of a drink per hour, while the typical female will burn up about one-half of a drink in that hour.

We can control the rate at which alcohol enters our bloodstream. For example, we can gulp down our drinks, or slowly sip them. We can drink on an empty stomach, or we can take the precaution of eating before drinking. We can choose to drink a lot, or a little. But once the alcohol gets into the blood, there is nothing we can do to affect how quickly it leaves. Coffee won't accelerate the rate at which our livers burn alcohol. Neither will exercise, or deep breathing, or a cold shower. We simply have to wait for the process of metabolism to move along at its own speed.

DOSE-RESPONSE RELATIONSHIPS

People sometimes ask, "how 'high' is 'drunk'?" What is the "legal limit" for "drunk driving"? How much can a person drink before becoming "impaired"?

There is no simple answer to these or similar questions, except to say that any amount of alcohol will affect a person's ability to drive to some degree. It is true that the laws of nearly all States establish a BAC limit at which it is explicitly unlawful to operate a vehicle. In those cases, that "limit" is 0.08 BAC. But every State also makes it unlawful to drive when "under the influence" of alcohol, and the law admits the possibility that a particular person may be under the influence at much lower BACs.

How much alcohol does someone have to drink to reach these kinds of BACs? Obviously, as we've already seen, it depends on how much time the person spends drinking, on whether the person is a man or a woman, on how large the person is, on whether the drinking takes place on an empty stomach, and on certain other factors. But let's take as an example a 175-pound man. If he drinks two beers, or two shots of whiskey, in quick succession on an empty stomach, his BAC will climb to slightly above 0.04. Two more beers will boost him above 0.08. One more will push him over 0.10. In one respect, then, it doesn't take very much alcohol to impair someone: "a couple of beers" can do it.

But in another respect, when we contrast alcohol with virtually any other drug, we find that impairment by alcohol requires a vastly larger dose than does impairment by the others. Consider exactly what a BAC of 0.08 means. Blood alcohol concentration is expressed in terms of the "number of grams of ethanol in every 100 milliliters of blood". Therefore, 0.08 means that there is 0.08 grams (g) of ethanol in every 100 milliliters (mL) of blood. You will find that BAC results are reported in a variety of units. Two common variations are milligrams/milliliters and percent. There are 1000 milligrams (mg) in one gram; therefore, 0.08 grams equals 80 milligrams (mg) and a BAC of 0.08 would be reported as 80 mg of ethanol/100 mL of blood. Percent means parts per one hundred. In this example 0.08 grams/100 milliliters of blood is equivalent to 0.08% BAC.

Note: The term BAC is used in the manual. However, it should be understood to refer to either Blood Alcohol Concentration (BAC) or Breath Alcohol Concentration (BrAC) depending on the legal requirements of the jurisdiction.

TEST YOUR KNOWLEDGE

INSTRUCTIONS: Complete the following sentences.

1. The average DWI violator commits that violation ____ times a year.
2. In typical enforcement jurisdictions one DWI violation in ____ results in arrest.
3. In the Fort Lauderdale study, police officers arrested ____ percent of the drivers they contacted whose BACs were .10 to .20.
4. Name three different chemicals that are **alcohols**. Which of these is **beverage alcohol**, intended for human consumption? What is the chemical symbol for beverage alcohol?
5. What is the name of the chemical process by which beverage alcohol is produced **naturally**? What is the name of the process used to produce **high-concentration** beverage alcohol?
6. Multiple Choice: "Blood alcohol concentration is the number of _____ of alcohol in every 100 milliliters of blood."
 - A. grams
 - B. milligrams
 - C. nanograms
7. True or False: Pound-for-pound, the average woman contains more water than does the average man.
8. What do we mean by the "proof" of an alcoholic beverage?
9. Every chemical that is an "alcohol" contains what three elements?
10. True or False: Most of the alcohol that a person drinks is absorbed into the blood via the small intestine.
11. What is the name of the muscle that controls the passage from the stomach to the lower gastrointestinal tract?
12. True or False: Alcohol can pass directly through the stomach walls and enter the bloodstream.

13. Multiple Choice: Suppose a man and a woman who both weigh 160 pounds arrived at a party and started to drink at the same time. And suppose that, two hours later, they both have a BAC of 0.10. Chances are
- A. he had more to drink than she did.
 - B. they drank just about the same amount of alcohol.
 - C. he had less to drink than she did.
14. In which organ of the body does most of the metabolism of the alcohol take place?
15. What is the name of the enzyme that aids the metabolism of alcohol?
16. Multiple Choice: Once a person reaches his or her peak BAC, it will drop at a rate of about _____ per hour.
- A. 0.025
 - B. 0.015
 - C. 0.010
17. True or False: It takes about thirty minutes for the average 175-pound man to "burn off" the alcohol in one 12-ounce can of beer.